GT KEY

Molarity & Limiting Reactants

1 Calc. Molarity.

a. $24.5\ g\ NaOH \times \frac{1\ mol\ NaOH}{40.0\ g\ NaOH} = 0.6125\ mol\ NaOH$

$$\frac{0.6125\ mol\ NaOH}{0.250\ L\ Soln.} = 2.45\ M\ NaOH$$

b.

2. Calc # grams solute.

a. $0.15\ M\ AgNO_3 = \frac{x\ mol\ AgNO_3}{0.125\ L\ soln} \longrightarrow 0.01875\ mol\ AgNO_3 \times \frac{169.88\ g\ AgNO_3}{1\ mol\ AgNO_3} =$

Ag - 107.87
N - 14.01
O - 16.00

$= 3.19\ g\ AgNO_3$

b.

3. Calc volume if each in mL

a. $0.50\ M\ NaCl = \frac{0.12\ mol\ NaCl}{x\ L\ soln.} = 0.24\ L\ Soln \times \frac{1000\ mL}{1\ L} = 240\ mL\ Soln$

b.

4. $3C_2H_5OH + PCl_3 \rightleftharpoons 3C_2H_5Cl + H_3PO_3$

C - 12.01
H - 1.01
O - 16.00
P - 30.97
Cl - 35.45

$112\,g\ C_2H_5OH \times \frac{1\,mol\ C_2H_5OH}{46.09\,g\ C_2H_5OH} = 2.43\,mol\ C_2H_5OH / 3 = 0.81\,mol$

$34.7\,g\ PCl_3 \times \frac{1\,mol\ PCl_3}{137.32\,g\ PCl_3} = 0.253\,mol\ PCl_3$ → limiting reactant

$0.253\,mol\ PCl_3 \times \frac{3\,mol\ C_2H_5Cl}{1\,mol\ PCl_3} \times \frac{64.52\,g\ C_2H_5Cl}{1\,mol\ C_2H_5Cl} = 49.0\,g\ C_2H_5Cl$ theoretical

$\frac{23.7}{49.0} \times 100 = 48\%$

$\left|\frac{Th - Exp}{Th}\right| \times 100 = \left|\frac{49.0 - 23.7}{49.0}\right| \times 100 = 51.6\%$ error

5. $6H_2O + 2N_2 \rightleftharpoons 4NH_3 + 3O_2$

$2.09\,g\ H_2O \times \frac{1\,mol\ H_2O}{18.02\,g\ H_2O} = 0.11598\,mol\ H_2O / 6 = 0.065429\,mol$ → limiting reactant

$11.0\,g\ N_2 \times \frac{1\,mol\ N_2}{28.02\,g\ N_2} = 0.39258\,mol\ N_2 / 2 = 0.196288\,mol\ N_2$

$0.11598\,mol\ H_2O \longrightarrow \times \frac{4\,mol\ NH_3}{6\,mol\ H_2O} \times \frac{17.04\,g\ NH_3}{1\,mol\ NH_3} = 1.32\,g\ NH_3$

$0.11598\,mol\ H_2O \times \frac{2\,mol\ N_2}{6\,mol\ H_2O} \times \frac{28.02\,g\ N_2}{1\,mol\ N_2} = 1.08\,g\ N_2$ used

$11\,g\ N_2 - 1.08\,g\ N_2$ used $= 9.92\,g\ N_2$ left

6. ① NO + O_2 ⟶ ② NO_2

0.866 mol NO / 2 = 0.433 mol NO R — limiting.

17.55 g O_2 × $\frac{1\text{ mol } O_2}{32.00\text{ g } O_2}$ = 0.5484 mol O_2 R — excess.

0.866 mol NO × $\frac{2\text{ mol } NO_2}{2\text{ mol NO}}$ × $\frac{46.01\text{ g } NO_2}{1\text{ mol } NO_2}$ = 39.84 g NO_2

7. MnO_2 + ④ HCl ⟶ $MnCl_2$ + Cl_2 + ② H_2O

0.86 mol MnO_2

H - 1.01
Cl - 35.45

48.2 g HCl × $\frac{1\text{ mol HCl}}{36.46\text{ g HCl}}$ = 1.32 mol HCl / 4 = 0.330 R mol — limiting.

1.32 mol HCl × $\frac{1\text{ mol } Cl_2}{4\text{ mol HCl}}$ × $\frac{70.9\text{ g } Cl_2}{1\text{ mol } Cl_2}$ = 23.4 g Cl_2

8. ② NH_3 + CO_2 ⟶ $(NH_2)_2CO$ + H_2O

637.2 g NH_3 × $\frac{1\text{ mol } NH_3}{17.04\text{ g } NH_3}$ = 37.39 mol NH_3 / 2 = 18.70 R mol — limiting.

1142 g CO_2 × $\frac{1\text{ mol } CO_2}{44.01\text{ g } CO_2}$ = 25.95 mol CO_2

37.39 mol NH_3 × $\frac{1\text{ mol } (NH_2)_2CO}{2\text{ mol } NH_3}$ × $\frac{60.07\text{ g } (NH_2)_2CO}{1\text{ mol } (NH_2)_2CO}$ = 1123 g $(NH_2)_2CO$

37.39 mol NH_3 × $\frac{1\text{ mol } CO_2}{2\text{ mol } NH_3}$ × $\frac{44.01\text{ g } CO_2}{1\text{ mol } CO_2}$ = 822.8 g CO_2 used.

1142 − 822.8 = 319.2 g CO_2 left

% Yield = $\frac{1000}{1135}$ × 100 = 88.11% Yield

#9 $Ca(NO_3)_2 + Na_2SO_4 \rightarrow$ N.R.

$0.0355\,L \times 0.25\,M = .008875$ mol $Ca(NO_3)_2$

$0.0505\,L \times 0.18\,M = .00909$ mol Na_2SO_4

$Ca(NO_3)_2 + Na_2SO_4 \longrightarrow 2NaNO_3 + CaSO_4$

$0.25\,M\ Ca(NO_3)_2 = \frac{x\ mol}{0.0355\,L} \longrightarrow 0.008875$ mol ← limiting

$0.18\,M\ Na_2SO_4 = \frac{x\ mol}{0.0505\,L} \longrightarrow 0.00909$ mol

#10 a) $0.008875\ mol\ Ca(NO_3)_2 \times \frac{1\ mol\ CaSO_4}{1\ mol\ Ca(NO_3)_2} \times \frac{136.15\ g\ CaSO_4}{1\ mol\ CaSO_4} = 1.20\,g$ ~~2.42g~~ $CaSO_4$

Ca - 40.08
S - 32.07
O - 16
= 136.15 g/mol

% Yield 82% $= 100\% \times \frac{x}{2.42\,g\ CaSO_4}$

$= 1.98 = 0.984\,g$ Exp Yield.